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RV DETECTION TECHNIQUES APPLIED TO ASW (S)

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I ABSTRACT

An important element in ASW is the requirement to determine submarine positions concerning which little or no a priori information is available. The identification of technologies available to meet this requirement, and an assessment of their effectiveness, is therefore an integral part of any ASW effort, both with regard to threat analysis and potential offensive use.

In this document we address the potential of a particular technology, RV detection,* as an appropriate location technology for the ASW effort. Data generated in various pilot studies, which include successful land-submarine communication and the location of a sunken ship, both by RV techniques, indicate overall feasibility of the proposed approach.

*Definition: The abbreviation RV refers to a human information-accessing capability called "remote viewing." RV pertains to the ability of certain individuals to access, by means of mental processes, information blocked from ordinary perception by distance or shielding.

II RV TECHNOLOGY

A. Background

Ongoing efforts in both the open[1-3] and classified[4-10] communities continue to provide evidence for the existence of so-called "parapsychological," psychoenergetic," or "psi" processes, a class of interactions between consciousness and the physical world as yet unexplained. Of particular interest along these lines (with regard to ASW) is the phenomenon called "remote viewing" (RV), the ability of certain individuals to access and describe, by means of mental processes, information blocked from ordinary perception by distance or shielding or both.

The RV data base generated at SRI International alone over the past decade consists of hundreds of experiments in the remote viewing of targets ranging from objects in nearby light-tight cannisters to geographic sites at intercontinental distances, viewed from locations which included shielded Faraday cages and a submerged submarine.

RV functioning has been examined both from the standpoint of U.S. use as an intelligence collection technique, and from the standpoint of threat analysis as to the vulnerability of U.S. systems and facilities. These efforts are presently being pursued at SRI International under a Joint Services Program sponsored by the Defense Intelligence Agency (DIA-DT). The appropriate points of contact are the DIA COTR in residence at SRI, [redacted] or, in the Washington, D.C. area, Dr. J. Vorona, DDS&TI, DIA, or his P.O.C. for this area, [redacted] (DT-1A).

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B. RV as a Search/Location Technology

In problems of the search/location type (such as ASW) the general prospect of a continuum of possible locations can usefully be reduced to that of a set of discrete possibilities. This is because specification of one of a number of grid squares is sufficient to define location, if the grid mesh is fine enough. With the task so defined (to be one of a discrete set of possibilities), then the location method can be designed around one of several standard formats for RV testing developed to handle one-in-N "guessing" games.

These formats generally consist of two parts: (1) repetitive choosing by the remote viewer of one from among a number of possible alternatives, and (2) some form of statistical averaging of such choices to average out the "noise" and peak the "signal."

C. One-in-N "Games"--Examples from the Literature

As a first example of the power of such techniques in general, we cite an experiment reported by Czech researcher Dr. Milan Ryzl, a chemist with the Institute of Biology of the Czechoslovakian Academy of Science. Ryzl worked with a subject whose base performance level was that he was generally capable of generating better than a 60% hit rate targeting on sequences of random binary digits, or bits (0, 1), where chance expectation was 50%. To apply this capability, Ryzl chose as a task the acquisition, without error, of a 50-digit random binary sequence. The effort took 19,350 calls, averaging 9 sec per call. The hit rate for individual calls was 61.9%, 11,978 hits and 7372 misses. By means of repeated passes through the sequence and an elaborate (though inefficient) majority-vote protocol, the subject was able to identify with <u>100% accuracy</u> all 50 bits.[11] The probability that he did so by chance is only one in 10^{15}.

As a second example, we cite an electronically-automated screening study carried out by Charles Tart of the University of California, Davis.[12] Subjects were asked to determine which one of ten possible positions on a circular display had been designated as an active target by the electronic test device's random number generator, an analog to determining grid positions of a submarine. From an unselected population of 2000 university students participating in a mass card screening program, seventy of the better subjects accepted an invitation to be further screened using the automated electronic testing system. Of these, ten were finally chosen to participate in a formal study involving 500 trials each. The results obtained with these ten subjects are shown in Table 1. It is seen that five of the ten subjects scored significantly above chance, all in the range of 1.5-2.5 times chance expectation. The best subject averaged a 24.8% hit rate ($\sim 2.5 \times$ chance) over the 500-trial sequence; the probability of such a result or better occurring by chance is only $p = 2 \times 10^{-28}$. With functioning of this quality, the application of statistical averaging techniques would quickly yield high-reliability results in a search/location problem, as is shown in Section III.

Table 1

ELECTRONICALLY-AUTOMATED SCREENING STUDY

Subject	(10% Expected)	Probability of Obtaining Such a Result by Chance (one-tailed)
1	24.8%	2×10^{-28}
2	20.6%	1×10^{-14}
3	16.2%	2×10^{-6}
4	16.0%	4×10^{-6}
5	15.6%	2×10^{-5}
6	11.8%	nonsignificant
7	11.4%	nonsignificant
8	10.8%	nonsignificant
9	9.4%	nonsignificant
10	7.8%	nonsignificant

III SUGGESTED METHOD OF APPROACH FOR ASW APPLICATION

With regard to determining the feasibility of the use of RV techniques in submarine location, an approach that recommends itself is a two-phase program involving (1) microcomputer-based training, and (2) demonstration-of-feasibility testing. These are discussed below.

A. Phase 1--Microcomputer-Based Training

1. Overall Approach

The first phase of the program would involve training a population of volunteers using microcomputer-based simulation of the submarine-location problem. Basically, the individuals participating are asked to select, on a repetitive basis, which one of, say, ten circles randomly displayed on a video monitor has been designated as the "target" by the computer's random number generator. In this simulation the ten circles correspond to ten possible grid-square submarine locations, with the computer-determined "target" circle designated as the actual location. The computer display is driven by an LSI-11 microcomputer which, on a trial-by-trial basis, generates a new random display of the circles. The individual enters his selections by button press on a hand device positioned over an X-Y grid (see Figure 1), and the computer responds by giving immediate feedback as to the correct answer (to encourage learning). As the trials progress, the selections are computer analyzed on line by a statistical averaging program, the output of which indicates whether one of the possibilities has been chosen statistically significantly more often than expected by chance.

FIGURE 1 COMPUTER MODELING TASK. The circles representing possible target locations are shown in the lower video monitor; a decision graph is shown on the upper monitor. The remote viewer's choice is entered by button press on hand device positioned over x–y grid.

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In the application (as contrasted to the simulation/training) mode, essentially the same procedure is followed, with the circles internally keyed to numbered grid-square alternatives. The procedure differs only in that trial-by-trial feedback would, of course, not be available in that case since the answer is unknown during the repetitive selection procedure.

2. Technical Discussion

An efficient statistical-averaging method for the grid-square selection process is provided by a standard sequential-sampling technique used in e.g., production-line quality control.[13] The sequential method gives a rule of procedure for making one of three decisions (with regard to each of the possible choices) following each selection attempt (trial): the acculated selections have met a pre-established hit-rate criterion (decision positive); the accumulated selections do not exceed chance expectation (decision negative); continue trials (insufficient data to make a decision). The sequential sampling procedure differs from fixed-trial-length procedures in that the number of trials required to reach a decision is not fixed, but depends on the results accumulated with each trial. The principal advantage of the sequential sampling procedure as compared with other methods is that, on the average, fewer trials per decision are required for an equivalent degree of reliability.

To apply the sequential analysis procedure, we must a priori define the hit rate we require to conclude that useful locational RV functioning is taking place, and what statistical risks we are willing to accept for making an incorrect decision.

To meet these criteria, the sequential analysis procedure requires the specification of four parameters to determine which outcome (chance or required-hit-rate) a series of trials corresponds to. They are: p_o,

the fraction of selections of a particular target expected in the chance condition (e.g., $p_o = 0.1$ for a one-in-ten grid-square problem); p_1, the fraction of selections expected in the presence of a functioning RV capability (e.g., $p_1 = 0.16$ for a $1.6 \times$ chance-expectation requirement, a value that might be chosen because of previous performance in a successful one-in-ten task); α, an a priori assigned acceptable error rate (e.g., $\alpha = 0.05$) for concluding that accumulated selections of a particular choice correspond to the p_1 (RV) case when in fact they correspond to the p_o (chance) case (Type I error); β, an a priori assigned acceptable error rate (e.g., $\beta = 0.05$) for concluding that accumulated selections of a particular choice correspond to the p_o (chance) case when in fact they correspond to the p_1 (RV) case (Type II error).

With the parameters thus specified, the sequential sampling procedure provides for construction of a decision graph of the type shown in Figure 2. The decision graph illustrates the rules of procedure for making one of the three possible decisions following each trial: continue test before making a decision (unshaded middle region in Figure 2); decision positive (upper shaded region in Figure 2); decision negative (lower shaded area in Figure 2). The equations for the upper and lower decision lines are given in the Appendix.

With the appropriate equations programmed into the microcomputer, the computer automatically records all data (trial number, target/response pair), and displays on the video graphics system progress on a target decision graph. A cumulative record of remote viewer selections is compiled by the computer until either the upper or lower decision line is reached, at which point a decision is made.

Also given in the Appendix are the equations for the average number of trials to make decisions, positive or negative. A plot of the average number of trials to reach a positive decision for typical cases

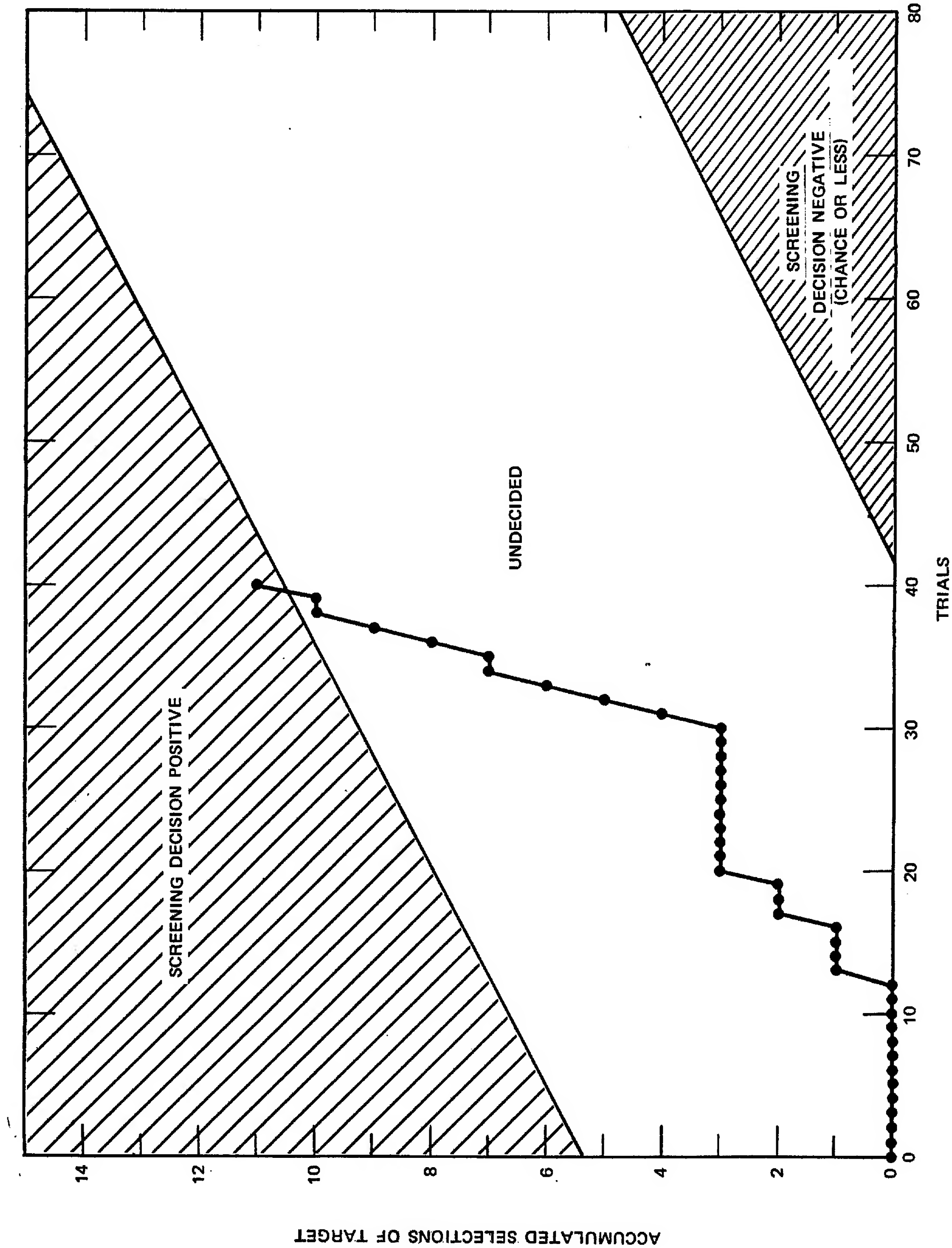

FIGURE 2 DECISION GRAPH FOR TARGET SELECTION
(5% Error Rates; 1.6 x Chance Expectation [1/10] Requirement)

of interest is shown in Figure 3, where 5% (α, β) error rates have been assumed. As an example, we see that for a twice-expectation rate (k = 2) hitter, $\bar{n}_1 \approx 60$ trials are required on the average to reach a positive decision on a one-in-ten target.

The overall system error is dependent on the type of mode employed in the RV position-location attempts.

(a) If the submarine-location task is approached with a tentative choice having already been made (e.g., by conventional technological means), then the task of the remote viewer is to verify or reject the tentative location as a backup test. In this mode, only a single decision graph is plotted for the target choice of interest. The probability of error due to chance ($P_{e,c}$) in this case $\sim\alpha$, being given by the product of the probability of making a selection even though operating at chance, and the percentage of such selections that correspond to an incorrect decision:

$$P_{e,c} = \left(\frac{N - 1}{N}\right) \alpha \quad .$$

(b) If the submarine-location task is approached as a blind one-in-N task (e.g., one-in-10 task), then N decision graphs are plotted in parallel, one for each of the N target choices, as each selection is being made. In this case, to a good approximation the graphs can be treated in the chance condition as independent, and the probability of error due to chance ($P_{e,c}$) ~ Nα. Specifically, it is given by the product of the probability of making at least one selection in the N graphs by chance (which is one minus the probability of making no selections), and the percentage of such selections that correspond to an incorrect decision:

$$P_{e,c} = \left(\frac{N - 1}{N}\right) \left[1 - (1 - \alpha)^N\right] \quad .$$

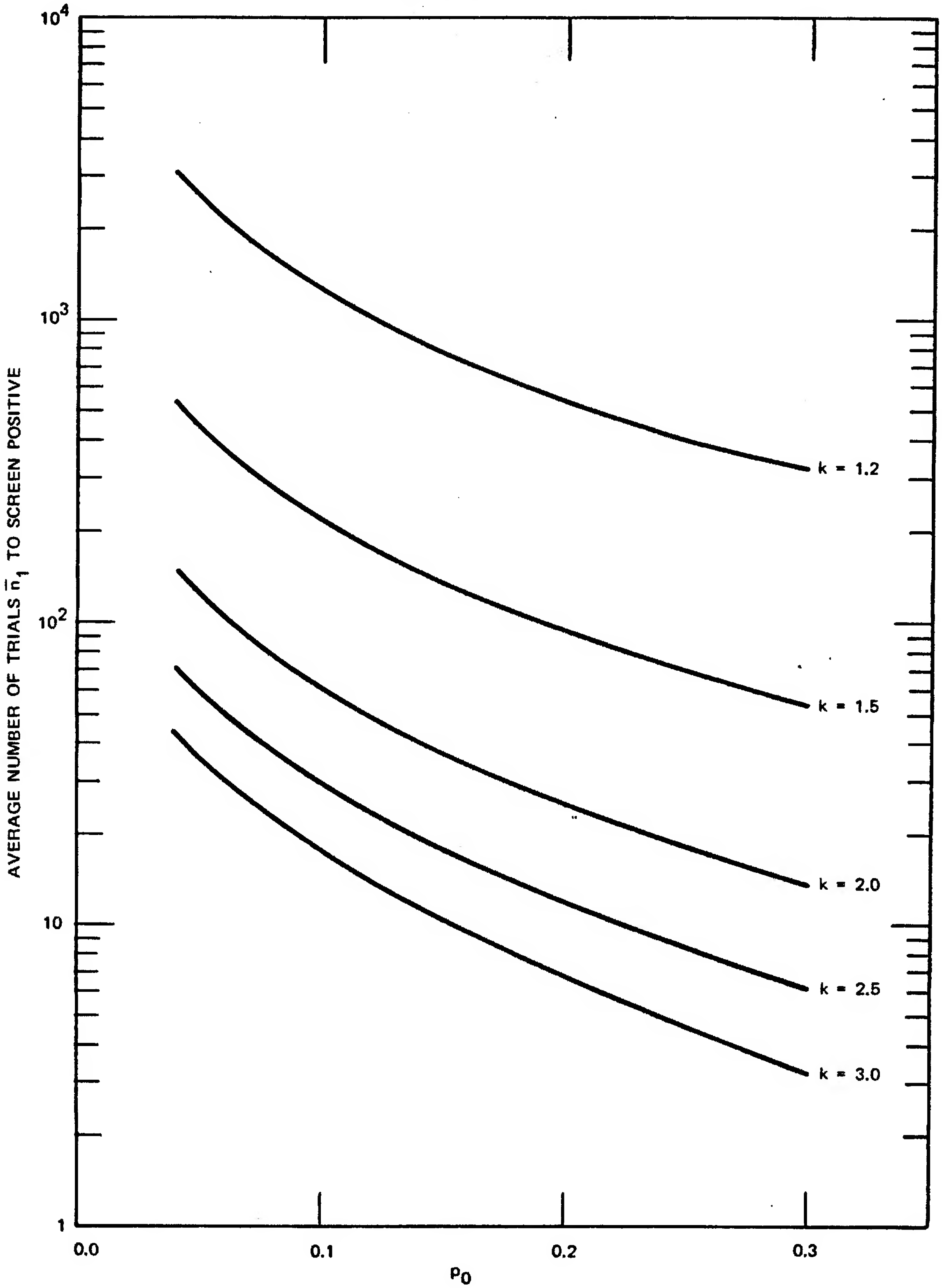

FIGURE 3 AVERAGE NUMBER OF TRIALS $\bar{n}_1$ TO SCREEN POSITIVE
p_0 = chance expectation = 1/N, where N is the number of alternatives.
p_1 = $k \times p_0$, where p_1 is the required hit rate and k is the associated strength parameter.
False alarm rates $\alpha = \beta = 0.05$ are assumed.

For example, in a one-in-ten case (N = 10) a 1% individual-target error rate ($\alpha = 0.01$) leads to $P_{e,c} = 0.086$, or a confidence factor $1 - P_{e,c} = 0.91$; this provides ~ a 9-fold increase in odds over the one-in-ten confidence factor expected by chance.

3. Test Case

In order to verify the feasibility of the above approach on the basis of actual RV-derived data, we examined data generated by a subject asked to identify, not which of ten grid squares was occupied by a submarine, but, analogously, which of ten circles on a display had been randomly chosen as the target circle by computer random number generator. The data (that generated by Subject #1, Table 1--500 trials, 24.8% hit rate on the one-in-ten task) were processed by passing it through the sequential analysis statistical averaging program with the parameters set to correspond to a twice-chance-expectation requirement and 5% error rates. The result: twelve one-in-ten targets were correctly identified, in a row, before the data stream ran out. The probability of such a track record occurring by chance is only $p = 10^{-12}$.

Although the above data were gathered under the condition that the correct answers were stored in the computer during the runs, and therefore trial-by-trial feedback could be given as the random number generator stepped through its program, the conditions are nonetheless sufficiently similar to the projected task that the results can be taken as evidence that the proposed approach is sound.

In the training program, participants would be trained by carrying out a similar task, first with trial-by-trial feedback to encourage learning, and then without feedback to model properly an application study. In this initial phase the target for each run would be designated internally by the computer's random number generator.

B. Phase 2--Demonstration-of-Feasibility Study

The participants who emerge from Phase 1 with successful performance profiles would then be asked to participate in Phase 2.

In Phase 2 the mechanics of microcomputer recording and analysis of subject selections is the same as in Phase 1. Phase 2 differs from Phase 1, however, in that a participant's selection from the random circle display, internally keyed to numbered grid-square location alternatives, cannot be internally compared to a recorded correct answer.

In this Phase 2 demonstration-of-feasibility study, the sponsor would be asked to construct for each test a finite list of potential alternative submarine locations one of which is known (or can be found out) to be correct. To carry out the test, a participant (or participants) would be briefed as to the task and then be asked to proceed as in Phase 1. The sequential sampling parameters in the microcomputer analysis program would be set in accordance with the performance profiles established by the participant(s) in the Phase 1 training study. The results generated by the participant(s) in response to the task would then be tabulated and submitted to the sponsor. Following a series of such tests, performance profiles for the individual participants and the overall data set would be evaluated to provide an estimate as to the feasibility of the proposed technique.

The probability of success in an ASW applications task is buttressed by the fact that (1) the statistical procedures described here have been successfully applied by us in an exploratory program to determine, by RV means, the location of hidden radioactive materials and (2) we were completely successful in a series of experiments with a submersible which included long-distance land-submarine communication,[7] and the location of a sunken ship, both by RV techniques.

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Appendix

The equations for the upper and lower limit lines in the sequential sampling procedure are, respectively,[10]

$$y_1 = d_1 + Sn$$

$$y_o = -d_o + Sn$$

where

$$d_1 = \frac{\log \frac{1-\beta}{\alpha}}{\log \left[\frac{p_1}{p_o} \frac{1-p_o}{1-p_1} \right]}$$

$$d_o = \frac{\log \frac{1-\alpha}{\beta}}{\log \left[\frac{p_1}{p_o} \frac{1-p_o}{1-p_1} \right]}$$

$$S = \frac{\log \frac{1-p_o}{1-p_1}}{\log \left[\frac{p_1}{p_o} \frac{1-p_o}{1-p_1} \right]}$$

The average number of trials required to reach a decision in the positive and negative directions, respectively, are given by

$$\bar{n}_1 = \frac{\beta \log\left(\frac{\beta}{1 - \alpha}\right) + (1 - \beta) \log\left(\frac{1 - \beta}{\alpha}\right)}{p_1 \log\left(\frac{p_1}{p_o}\right) + (1 - p_1) \log\left(\frac{1 - p_1}{1 - p_o}\right)}$$

$$\bar{n}_o = \frac{(1 - \alpha) \log\left(\frac{\beta}{1 - \alpha}\right) + \alpha \log\left(\frac{1 - \beta}{\alpha}\right)}{p_o \log\left(\frac{p_1}{p_o}\right) + (1 - p_o) \log\left(\frac{1 - p_1}{1 - p_o}\right)} .$$

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